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OBSERVATIONS AND NOTES ON
THE REARING OF *PAPILIO INDRA*
KAIBABENSIS (PAPILIONIDAE)

RONALD S. WIELGUS

3434 W. Augusta, Phoenix, Arizona 85021

ON 31 MAY 1970 FIVE LARVAE of *Papilio indra kaibabensis* Bauer were found by the author on individual host plants of *Pteryxia petraea* (Jones) Coult. & Rose growing on the slopes and along the North Kaibab Trail opposite Roaring Springs, North Rim, Grand Canyon National Park, Arizona. These were taken back to Phoenix on 1 June 1970 along with a small amount of host plant material in an attempt at rearing. No previous attempt at rearing the larvae of this choice swallowtail had been made by the author.

The larvae found ranged as follows: one first-instar, one second-instar and three third-instars. These were numbered 1 through 5 respectively, to facilitate recording of individual behavior during the rearing process. Upon arrival at Phoenix it was discovered that larva No. 5 had moulted sometime during the several hours' return drive.

The larvae were kept indoors at a constant 80° F. and fed on the leaves of the host plant for five days, to 6 June 1970, during which time the host plant, in a vase of water, dehydrated and became stiff and brittle. By this time four of the five larvae had moulted and there were now one first-instar, one third-instar, two fourth-instars and one fifth-instar. It was immediately apparent that successful continuation of the rearing was dependent upon the acceptance by the larvae of substitute host plant. Emmel and Emmel (1967) found *Tauschia arguta* (T. & G.) to be an acceptable substitute and successfully reared *kaibabensis* larvae to maturity on it. This plant was not available to the author. It may have been possible to secure additional *Pteryxia* plants which also grow on the slopes at the South Rim of the Grand Canyon but, in view of the distance and time involved,

it was determined expedient to induce the larvae to accept still another member of the *Umbelliferae* as a substitute host.

An attempt to reconstitute half of the remaining *Pteryxia* plants by soaking in water for several hours was not successful. The remains of the other half of the original host were then placed in a small cooking pan holding approximately one pint of water, which was then heated and brought to a boil and then allowed to simmer for five minutes. The resulting solution was then poured into glass jelly jars, capped and allowed to cool. After cooling, this solution was used to water individual potted plants of young (less than one foot high) Fennel (*Foeniculum vulgare*). The watering was maintained on an hourly basis for several hours, during which time the larvae were allowed to find what little nourishment and moisture remained in the first remaining half of the original host. The third-instar, No. 2, and the two fourth-instar larvae, Nos. 3 and 4, moulted unobserved prior to inspection on the morning of the seventh.

In the early morning of 7 June 1970 each larva was transferred to its individual potted Fennel plant in the hope of obtaining acceptance. Larva No. 1 immediately accepted the substitute host and fed periodically until the afternoon of the eighth. Toward the end of that day it ceased feeding and remained head downward on a petiole. It was determined that this larva was preparing to moult.

The other larvae did not readily accept the Fennel and crawled restlessly over the soil in the pots. Cut sprigs of fresh, tender Fennel were then placed on the soil in each pot where the larvae crawled, as it observed that the larvae experienced great difficulty in attempting to crawl up the Fennel stems. Even with this method the larvae nibbled but briefly on the Fennel tips, which apparently did not completely satisfy their dietary requirements, and continued their restless movements. The feathery growth of the Fennel appeared to hamper the crawling progress of the larvae and they continually lost footholds and rolled over on their sides and backs.

On the morning of 8 June 1970 larvae Nos. 2, 3, 4 and 5 were removed from the pots and placed in individual empty one pound coffee cans. On the inside bottom of each can a cut-to-fit disk of household papered towelling had been placed and on this fresh sprigs of Fennel were laid. These sprigs were at first obtained from the plants which had been watered with the solution. The cans were then capped with the standard plastic

lid that comes with each can and placed on a window sill away from direct sunlight. This technique resulted in high humidities inside the rearing cans but also served to prolong the freshness of the foodplant. As the Fennel wilted in the course of time it became necessary to replenish the rearing cans with fresh material. This was done periodically during the day and on into the evening hours. Each can was also emptied of accumulated frass and a clean paper towel disk inserted. About 7:00 P.M. (M.S.T.) of the same day larva No. 4 began to feed earnestly on the Fennel and continued for approximately twenty minutes. This was in marked contrast with the earlier behavior which exhibited rejection of the substitute host after several nibbles. The two other fifth-instar larvae continued to maintain their restlessness, pausing only occasionally to nibble, then resuming their crawling. The fourth-instar larva, No. 2, remained quiescent and moulted unobserved early on the morning of the ninth.

On the morning of 9 June 1970 a review of the rearing cans revealed that, of the three later fifth-instar larvae, No. 5 remained motionless on its side on the bottom of the can in the characteristic attitude assumed by *Papilio* larvae prior to pupation. This was confirmed by examination of the larva through whose skin pupal features were distinguishable. It was noted that this larva failed to spin the silken button and girdle so characteristic of pupating larvae of this family. This may have been due to the smooth metal side of the rearing can which afforded little foothold for the larva. No difficulties were experienced, however, with similar rearing conditions for larvae of *Papilio cresphontes cresphontes* Cramer, which simply spun silken mats up a can's side to their pupation sites. Of the other two larvae, No. 4 continued feeding and No. 3 continued its virtually ceaseless crawling. A stiff sheet of paper placed vertically in the latter's can did not elicit a response toward selection of a pupation site and was ignored. The newly-moulted fifth-instar larva, No. 2, accepted the Fennel and fed eagerly after its mouthparts were sufficiently hardened. Larva No. 1 continued to feed for a time after moulting but then contracted an undetermined ailment, evidenced by an expelling of a greenish liquid from the mouth and excretion of a liquid frass. This larva rapidly lost the ability to maintain a grip on the substitute host, dropping to the soil and expiring shortly thereafter.

Larva No. 5 which had been determined to be prepupal was placed in an upright tube of rolled stationery paper of slightly

longer length. On the morning of 10 June 1970 an examination revealed that this larva had transformed to a chrysalis of slightly smaller proportions (Emmel & Emmel, 1967), measuring 24 mm. long by 8 mm. wide. This may have been brought about by a reduced intake of nourishment in the last larval instar.

It was of interest to note that, with the exception of the expired No. 1 larva, the other larvae experienced great difficulty in maintaining footholds and equilibrium on the Fennel sprigs. This was not the case with larvae of *Papilio zelicaon* Lucas which the author has successfully reared on Fennel under similar rearing conditions. Also of interest was the habit of *kaibabensis* larvae of remaining quiescent for long periods of time, on the order of a couple hours' duration or more between feedings in several instances, yet larval growth appeared to be rapid. Feeding was noted to be avid in all stages, both on *Pteryxia* and Fennel. Some difficulty was experienced by the larvae feeding on the Fennel sprigs as the long, thin filaments continually slipped past their grip. A preference was shown for feeding to begin at the terminal portion of each filament, though in some instances the larvae would nip off the filaments mid-way and feed upon the cut-off portions by holding these with their true legs. After the larvae had fed several times upon the Fennel sprigs from the plants watered with the solution, they were given fresh sprigs from untreated plants. These were accepted without hesitation. From then on only sprigs from untreated plants were offered to the larvae.

At 10:09 P.M. (M.S.T.) larva No. 3, which had previously exhibited the most reluctance to feed, accepted the Fennel and proceeded to feed avidly for approximately 10 minutes, whereupon feeding terminated and did not resume again. Symptoms of the ailment noted with larva No. 1 were exhibited by this larva at 6:15 P.M. (M.S.T.) on 11 June 1970. The larva gradually lost mobility and slowly shrank in size during the next several hours. However expiration, which appeared to be caused by a combination of starvation and dehydration, did not occur until 12 June 1970, probably due in part to the larger size of this larva. At 7:30 A.M. (M.S.T.) of that day larva No. 4 also excreted a voluminous liquid frass but did not exhibit the fatal symptoms previously noted in the other larvae. Instead it proceeded to fashion a silken mat on the side of the rearing can prior to assuming the pupation position and at 9:45 P.M. (M.S.T.) it slipped into the silken girdle. Pupation took place

unobserved during the early morning hours of the fourteenth. This chrysalis measured 29 mm. long by 9 mm. wide.

Larva No. 2 continued to feed on the Fennel until 15 June 1970. Prior to selecting a pupation site, in this case on the screen cover which replaced the plastic lid when the larva ceased feeding, this larva, too, excreted a voluminous liquid frass and soiled the paper towel disk extensively. It is not known at this time whether defecation of a liquid frass at larval maturity is the rule with this species or is caused by feeding on Fennel. This larva pupated at 11:30 P.M. (M.S.T.) on 16 June 1970 and a perfect adult female eclosed prior to sunrise on 28 June 1970.

However, the chrysalis of larva No. 4, which had developed to the verge of eclosion, died of unknown causes on 26 June 1970. At the time of this writing, 28 June 1970, the chrysalis produced by larva No. 5, though still viable, shows no signs of development and may have entered diapause.

It is interesting to speculate on the possibility of selective breeding utilizing larger numbers of larva in order to develop Fennel feeding populations. Since Fennel is easily grown from seed, such host acceptance would offer wider study by serious workers of the biology of this member of the *indra* complex. The small sample combined with high mortality did not permit the author to pursue this facet of his rearings.

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LITERATURE CITED

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POSTSCRIPT

The chrysalis produced by larva No. 5 on 10 June 1970, which indeed had entered diapause, eclosed a perfect female at dawn on 25 September 1970. Diapause was terminated by refrigerating the chrysalis for thirty days, from August 4 to September 4, then removing from refrigeration and maintaining at room temperature until eclosion. During the period prior to eclosion humidity was provided by placing the paper cylinder containing the chrysalis on a water-moistened paper towel.